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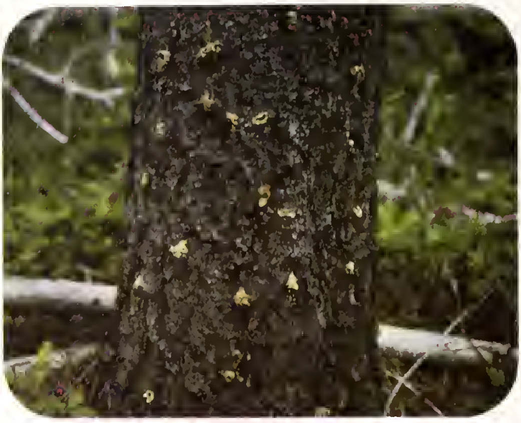
ORANGE TREES IN A GREEN LANDSCAPE

What's Going On Here?



For the past few years, two forest insects have been enjoying very favorable growing conditions, resulting in many dead and dying trees that stand out so plainly in the landscape of Yellowstone National Park. Perhaps you have seen the orange or brownish-red lodgepole pines along the Madison River if you entered Yellowstone through the West Entrance, or while hiking in the Bechler region in the southwest corner of the park. Along the road from Mammoth to Tower Falls you may have noticed stands of Douglas firs with very sparse crowns and many dead saplings.

By closing examining these trees, some other tell-tale signs can usually be found. Douglas firs, with their flattened needles, appear to be covered with wispy fragments of many spider webs. From dozens of the slender threads tiny caterpillars are suspended while others are found nibbling away at the tender green foliage of branch tips. Groups of the involved firs will have a grey appearance. In other areas, the needles of certain trees are a brownish-red to bright orange color and may be falling from the branches. For these lodgepole pine (2 needles to a bunch) something else may be present: a fine "sawdust" appears in the crevices of the bark and around the base of the tree. There are often patches of sticky pitch, either cream-colored or darker, around the circumference of the trunk. Finally, if you were to look at some of the wood immediately beneath the bark you would find that it has been stained a greenish-blue.

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Two Insects

The cause of these phenomena are two tiny insects that, individually, would be very easy to overlook with a casual glance. The mountain pine beetle (*Dendroctonus ponderosae* Hopkins) is an insect that, in the adult stage, is a dark brown to black beetle averaging about one-fifth of an inch in length. This tiny beetle feeds almost exclusively on inner bark of lodgepole pine. The second insect has the scientific name of *Choristoneura occidentalis* Freeman commonly known as the western budworm. The adult stage is not a beetle but a mottled, buff-colored moth, about three-fourths of an inch long. In Yellowstone National Park this insect favors Douglas fir, subalpine fir, or Engleman spruce as a source of food for its larvae. When either the budworm or the pine beetle show any kind of population boom the effects are the same, dead and dying trees.

Yet these insects have a role to play, and a very positive one at that, in the complex scheme of energy exchanges that take place in a natural ecosystem. Their life cycles are really fascinating stories of how two different niches have been successfully used in the forest environment.

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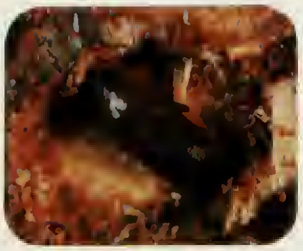
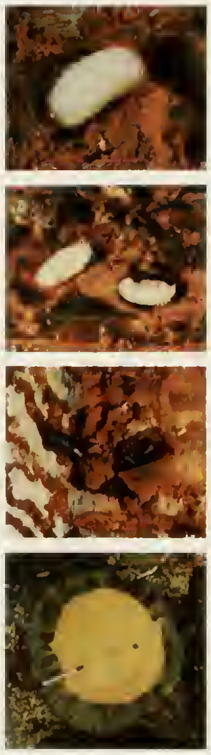


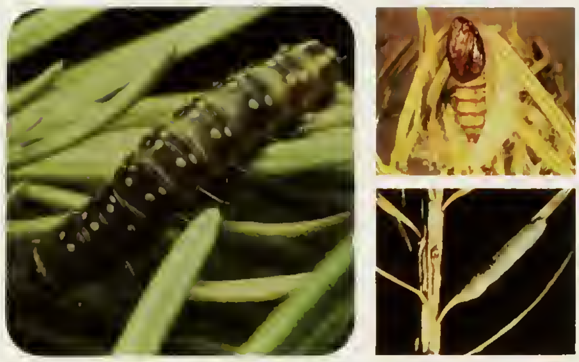
Mountain Pine Beetle

The two insects each have different tactics in gaining the necessary food energy from their host trees. The mountain pine beetle actually spends most of its life cycle within the living tree, under the bark and confined to a narrow layer between bark and wood. New beetles emerge in July and August to begin the next generation, although in some years the flight period may last until September. As the females fly through the forest looking for suitable trees in which to feed and mate, their instinctive behavior leads them to search for large, dark objects against a light background. The trunks of the trees that they alight on, then, will usually be the largest within any particular stand and also those with the greatest potential food supply to help ensure success for their broods. Boring into the bark, the females soon become surrounded by resin. As they continue to feed, a portion of this resin passes through their digestive tracts and becomes combined with a hormone-like substance known as a pheromone. Even in minute quantities this chemical serves as a powerful means of attracting other beetles. Males and females sensing this odor begin to converge on the tree. The first layer of inner wood is used for the construction of vertical galleries where the fertile egg masses are laid. The larvae (tiny white grubs) that hatch feed in the complex layer of living tissue (phloem) just inside the bark. It is through the phloem that the tree distributes the food produced in the needles. Larvae overwinter inside the tree in a dormant state and resume their feeding and development in the spring, passing into a third, or pupal stage, before midsummer. These actively feeding grubs inside a lodgepole pine cause the needles to change from green to yellowish-green in the spring and finally to a bright orange by July when the first of the new brood of beetles is ready to emerge. By this time the trunk has been girdled inside the bark and the flow of nutrients from the tree roots through the phloem has stopped. The xylem, or woody portion of the tree of lodgepoles, is also involved in the pine bark beetle life cycle. This tissue contains the water-conducting vessels as well as the major supporting fibers. Parent beetles bring with them several species of fungi that produce a blue stain. As these fungi begin to grow in the xylem they prevent the free flow of water from roots to needles. Lodgepoles that have well developed blue-stain tend to dry more quickly in the fall but remain more moist the following summer. These are just the conditions the pine beetles need for their best development.



Western Budworm

In contrast to the mountain pine beetle, the western budworm is an insect that can be found in the foliage part of the tree during the active phases of its life cycle. Here it feeds on the green Douglas fir or spruce needles that are its principle source of food. Like the pine beetle and many other insects, the budworm exhibits four stages of development: from egg, to larva—in this case caterpillars, a pupal stage, and finally the adult moth. The arrival of the first snows in Yellowstone National Park find the tiny larvae securely sheltered from winter's frigid temperatures under bark scales or other protected crevices of their host trees. These small caterpillars will remain snugly in place until May when increasing daylight and warmer days should have ensured a good start on that year's new bud growth. In the event that an extended winter and cool spring will have delayed the growth of new buds, the caterpillars mine the inside of old needles for the stored nutrients they contain. As new foliage appears, the larvae shift over to these more succulent needles. By mid-July the caterpillars have grown from the size of a matchhead to about one inch in length and are ready to pass through a period of rest in which they develop into the next, or pupal, stage. A loose cocoon is made by lightly webbing together a group of needles to house a single larva that will finally emerge as an adult moth in 10 to 12 days. The female moths that emerge are already too heavily laden with eggs to fly very far so mating and the laying of eggs usually occurs on nearby foliage. Again, a pheromone will serve to attract mates, in this case a chain-like molecule released by the female that can be detected by males literally miles away. This can be important when winds and updrafts transport moths far from the tree in which they emerged. In some cases moths have been known to travel as far as 50 miles during their late July flight period. The egg masses are laid on a single needle, from 10 to 50 at a time, and have the appearance of pale green overlapping fish scales. When the new larvae hatch, in about 10 days, they spend little time feeding but instead hibernate almost immediately and this completes the western budworm's life cycle.



WHAT'S GOING TO HAPPEN IN YELLOWSTONE NATIONAL PARK?

The Forest Remains

The mountain pine beetle and western budworm have existed in Yellowstone's forests ever since these forests came into being, thousands of years ago. Outbreaks of high populations have probably lasted no more than 1 to 5 years at a time, and most for less than 10 years, as they do today. Eventually, unfavorable weather, reduced numbers of large trees, or predation by other insects and birds curb the cycle and the forest remains. It has not been destroyed. These outbreaks are neither good nor bad, but rather they are part of a natural system that is helping to preserve the character of Yellowstone's forests. They are an important part of the amazing world of this wilderness national park.

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Photos by National Park Service,
Laird Robinson, and U.S.D.A. Staff

Published by:
Yellowstone Library and Museum Association